

REMARKS

Claims 1-13, 15, 23, 24, and 26-29 are pending in the application upon entry of the amendments and new claims. Claims 1, 6, and 9, have been amended to better describe the subject matter thereof. Claims 26-29 have been added to further describe the invention. Favorable reconsideration is respectfully requested in view the amendments, new claims, and remarks.

The Amendments

Claims 1, 6, and 9, have been amended to disclaim certain amine-borane compounds: Specifically, tertiary amine amine-borane compounds are disclaimed. New independent claim 26 is analogous to claim 1 except that pH and temperatures are more specifically described instead of more specifically describing the amine-borane compounds.

The First Rejection Under 35 U.S.C. §103(a)

Claims 1-8 and 23 stand rejected under 35 U.S.C. §103(a) over JP 63-239848 (hereinafter "JP '848") in combination with JP 10-245693 (hereinafter "JP '693") and Passal (U.S. Patent 3,697,391).

JP '848 relates to a method for manufacturing a lead frame comprising electroplating a Ni-Co-B alloy layer on the surface of a lead frame. In JP '848, an electroplating bath for electrodeposition of Ni-Co-B alloys on copper lead frames contains nickel ion, cobalt ion and trimethylamine borane. The purpose of JP '848 is to obtain a Ni-Co-B alloy securely bonded to a copper lead frame.

JP '693 relates to forming a nickel alloy by electroplating. JP '693 requires the brightener N-heterocyclic quaternary ammonium salt to function by inhibiting plating on insulation materials.

Passal relates to a process for electroplating Ni, Co, or Ni-Co alloys, wherein all metals are plated in ionic form. Passal uses a primary brightener (including

acetylenics), a secondary brightener, and an organic hydroxy-sulfonate adduct to improve tolerance to metallic impurities.

The Examiner contends that it would have been obvious to modify the method of JP '848 by additionally using one of the N-heterocyclic quaternary ammonium salt brighteners of JP '693, but then just before actually using the bath of JP '848 modified by JP '693, substituting an acetylenic brightener of Passal for the N-heterocyclic quaternary ammonium salt brighteners of JP '693. Applicants respectfully disagree.

The Deficiencies of The Cited Art Relative to The Claim Features

It is noted that the claims have been amended to disclaim tertiary amine amine-borane compounds. In this connection, the claims require primary and secondary amine-borane compounds, such as one or more of dimethylamine borane, t-butylamine borane, and hydrates thereof. Consequently, the differences between the independent claims and JP '848 are much more pronounced.

The steric difference between one or two alkyl groups (primary and secondary amine-borane compounds) and three alkyl groups (tertiary amine amine-borane compounds) on the nitrogen of the amine-borane compounds is significant and causes different reaction kinetics and other physical differences.

For example, there is a considerable solubility difference between primary/secondary amine-borane compounds and tertiary amine amine-borane compounds that makes them non-equivalent. Dimethylamine borane and t-butylamine borane have more than an order of magnitude better aqueous solubility than the trialkylamine boranes. Furthermore, the complexes formed from trialkylamine boranes are markedly more stable than monoalkyl/dialkylamine boranes. This is important because the postulated reaction mechanism requires the release of elemental boron to the plating surface through the metal Borine radical, $\text{Ni}\cdot\text{BH}_3$ (or $\text{Co}\cdot\text{BH}_3$), which is hindered if the metal amine complex is too strong. The stronger complex of trialkylamine boranes does not readily or easily allow for incorporation of B into the deposit matrix.

Different amine-borane compounds have different reduction potentials. Different amine-borane compounds also have different pH and temperature operating values. Specifically comparing the independent claims to JP '848, due to the stronger complex of trialkylamine boranes, trimethylamine borane would have insufficient activity to deposit significant amounts of boron in the alloy at the same temperatures compared to using monoalkyl/dialkylamine boranes, and much higher temperatures would be required to be attempted compared to using monoalkyl/dialkylamine boranes. The use of higher temperatures during plating introduces a host of additional problems, such as increased bath instability, increased corrosion, increased danger, and the like. For this additional reason, claims 5, 10, and 26 which contain temperature limitations are patentable over the cited art.

In sum, JP '848 fails to teach or suggest the use of one or more of dimethylamine borane, t-butylamine borane, and hydrates thereof in electroplating. Moreover, owing to the physical and functional differences between primary/secondary amine-borane compounds and tertiary amine amine-borane compounds, JP '848 would not have motivated one skilled in the art to employ one or more of dimethylamine borane, t-butylamine borane, and hydrates thereof in electroplating nickel, cobalt, and boron alloys.

Neither JP '693 nor Passal teach or suggest the use of dimethylamine borane, t-butylamine borane, and hydrates thereof in electroplating. And Neither JP '693 nor Passal would have motivated one skilled in the art to employ one or more of dimethylamine borane, t-butylamine borane, and hydrates thereof in the process of JP '848. For at least these reasons, withdrawal of the art rejections is respectfully requested.

The Deficiencies of The Cited Art Relative to The Art Combination

The N-heterocyclic quaternary ammonium salt brighteners of JP '693 are employed to suppress metal deposition on insulator material such as glass or ceramic. There is NO teaching or suggestion in JP '693 indicating that its N-heterocyclic

quaternary ammonium salt brighteners would be effective for improving the appearance of Ni-Co-B alloys. There is NO teaching or suggestion in JP '693 indicating that its N-heterocyclic quaternary ammonium salt brighteners cause the uniform placement of boron, in an electroless fashion, within the matrix of a Ni-Co alloy. In fact, the N-heterocyclic quaternary ammonium salt brighteners of JP '693 prevent all metal deposition on insulator materials.

The brighteners of Passal are employed to improve the appearance of electrodeposited Ni, Co, or Ni-Co alloys. There is NO teaching or suggestion in Passal indicating that its acetylenic brighteners would be effective for improving the appearance of Ni-Co-B alloys. There is NO teaching or suggestion in Passal indicating that its acetylenic brighteners cause the uniform placement of boron, in an electroless fashion, within the matrix of a Ni-Co alloy.

While JP '848 relates to making a Ni-Co-B alloy, JP '848 is silent as to brighteners in general. Thus, there is NO teaching or suggestion in JP '848 to employ an N-heterocyclic quaternary ammonium salt brightener or an acetylenic brightener. The objective of JP '693 is to use an N-heterocyclic quaternary ammonium salt brightener to suppress metal deposition on insulator material. The objective of JP '848 is to obtain a Ni-Co-B alloy securely bonded to a copper lead frame. There is NO motivation for one skilled in the art to combine an N-heterocyclic quaternary ammonium salt brightener which suppresses metal deposition on insulator material in the process of JP '848 which seeks to securely bind a Ni-Co-B alloy to copper.

The Examiner specifically cites paragraph [0015] of JP '693. This paragraph states that one should add a small amount of an N-heterocyclic quaternary ammonium salt brightener because adding a large amount of the N-heterocyclic quaternary ammonium salt brightener causes reduction decomposition. The Examiner contends that this paragraph teaches adding a pyridinium salt brightener reduces decomposition of the electroplating bath. However, this paragraph only states that one should add a small amount of an N-heterocyclic quaternary ammonium salt brightener instead of a

large amount. This paragraph relates to the amount of brightener, is does NOT teach that the pyridinium salt brightener reduces decomposition of the electroplating bath.

The function of the N-heterocyclic quaternary ammonium salt brightener of JP '693 is clearly described in paragraphs [0009], [0012], and [0016]. More specifically, the function of the N-heterocyclic quaternary ammonium salt brightener of JP '693 is to suppress metal deposition on insulator materials (plating inhibitors).

The Examiner contends that one skilled in the art would add the pyridinium salt brightener of JP '693 into the bath of JP '848 to reduce decomposition of the bath. However, since JP '693 does NOT teach that the pyridinium salt brightener reduces decomposition of the electroplating bath but instead teaches that the pyridinium salt brightener is a plating inhibitor, one skilled in the art would not have employed it in the bath of JP '848. Moreover, since the objective of JP '848 is to obtain a Ni-Co-B alloy securely bonded to a copper lead frame, one skilled in the art would NOT IGNORE or CONTRAVENE this plain, simple, direct, teaching, with an additive that work against the desired objective. For at least these two reasons, one skilled in the art would not have combined JP '693 and JP '848.

The Examiner further contends that one skilled in the art would NOT actually add the pyridinium salt brightener of JP '693 into the bath of JP '848, but instead substitute an acetylenic brightener of Passal for the pyridinium salt brightener of JP '693 into the bath of JP '848, because Passal teaches that acetylenic brighteners and pyridinium salt brighteners are functionally equivalent. While Passal lists many specific and generic descriptions of brighteners, Passal does NOT teach that all brighteners are functionally equivalent. And one skilled in the art would understand this simple fact: all brighteners are NOT functionally equivalent. It is noted that NOWHERE in Passal are acetylenic brighteners and pyridinium salt brighteners described as functionally equivalent.

The brighteners of Passal are employed to improve the appearance of electrodeposited Ni, Co, or Ni-Co alloys. There is NO teaching or suggestion in Passal indicating that its acetylenic brighteners would be effective for improving the appearance of Ni-Co-B alloys. Making the Ni-Co-B alloys as required by the claims

involves the uniform placement of boron, in an electroless fashion, within the matrix of a Ni-Co alloy. There is NO teaching or suggestion in Passal indicating that its acetylenic brighteners improve the appearance of electrodeposited Ni-Co-B alloys, and there would have been no reason to expect such an outcome.

Finally, one skilled in the art with knowledge of the reduction power of borane chemistry would not have combined an acetylenic brightener in an electroplating bath containing an amine-borane due to the possibility of lack of additive stability in the presence of the amine-borane. There are at least two reasons for this. The first reason is the concern about possible undesired hydroboration of the alkyne. Reactions of the borane moiety with alkynes are known to produce vinyl borane at the site of the triple bond (or in many cases a di-boron alkanes), destroying the acetylenic. While typically done in a non-aqueous setting, the strong reducing power of the amine-borane is known to have deleterious effects on a variety of organic species. The second reason is concern over the liberation of hydrogen from the amine-borane reduction of metal causing hydrogenation of the acetylenic, again losing the functionality of the triple bond during the plating. For example, catalytic reactions involving nickel ions to add either hydrogen or water across the triple bond are known.

Therefore, there would have been no motivation for one skilled in the art to modify JP '848 by using an acetylenic brightener of Passal and/or any teachings of JP '693.

The Second Rejection Under 35 U.S.C. §103(a)

Claims 9-12, 15, and 24 stand rejected under 35 U.S.C. §103(a) over JP '848 in combination with JP '693 and Passal. The arguments presented in the rejection above, apply to this rejection as well. Moreover, it is noted that trimethylamine borane is no longer covered by the claims, nor is trimethylamine borane equivalent to those borane compounds required by the claims.

The Third Rejection Under 35 U.S.C. §103(a)

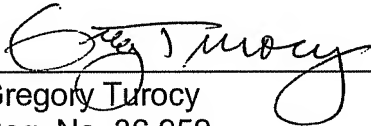
Claim 13 stands rejected under 35 U.S.C. §103(a) over JP '848 in combination with JP '693 and Passal in view of SU 1,544,847 (hereinafter "SU '847"). The arguments presented in the rejection above involving the independent claims, apply to this rejection as well. SU '847 does not cure the deficiencies of the combined teachings of JP '848, JP '693, and Passal, nor does SU '847 provide the missing motivation to combine JP '848, JP '693, and Passal in the manner proposed by the Examiner.

Should the Examiner believe that a telephone interview would be helpful to expedite favorable prosecution, the Examiner is invited to contact Applicants' undersigned attorney at the telephone number listed below.

In the event any fees are due in connection with the filing of this document, the Commissioner is authorized to charge those fees to our Deposit Account No. 50-1063.

Respectfully submitted,

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